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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/817,696	03/23/2001	Howard R. Test	TI-30589	9347

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EXAMINER

RICHARDS, N DREW

ART UNIT	PAPER NUMBER
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2815

DATE MAILED: 04/28/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 09/817,696	<b>Applicant(s)</b> TEST ET AL.	
	<b>Examiner</b> N. Drew Richards	<b>Art Unit</b> 2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 30 January 2004.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 7-26 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 7-16, 18-22 and 24-26 is/are rejected.
- 7) ☒ Claim(s) 17 and 23 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 23 March 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
     Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
     Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### ***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 7, 8, 11-13, 15, 16, 18, 19, 22, 24 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ulrich et al. ("Thermosonic Gold Wirebonding to Electrolessly-Metallized Copper Bondpads over Benzocyclobutane," 1999 International Conference on High Density Packaging and MCM's, Pp. 260-265).

Ulrich et al. teach a method of forming metallurgical connections between metal wires and bond pads having copper metallization. Ulrich et al. teach the steps of:

depositing seed metal to activate the surface of the copper metallization of the bond pads (see paragraph 5 of "Preparation of Test Structures" section);

plating a layer of barrier metal, by electroless deposition (Ni deposited, see paragraph 5 of "Preparation of Test Structures" section);

plating a layer of a bondable metal, by electroless deposition (Au deposited, see paragraph 5 of "Preparation of Test Structures" section);

and bonding one of the metal wires onto the outermost metal (wirebonding of gold to Cu bond pads, see abstract).

With regard to the thickness of the barrier metal being sufficient to resist copper diffusion at 250 degrees C by more than 80% compared with the absence of the barrier

layer, Ulrich et al. teach using Ni as the barrier metal and forming it to a sufficient thickness to obtain the claimed diffusion reduction.

With regard to the thickness of the bondable metal being sufficient to reduce the diffusion of the barrier metal at 250 degrees C by more than 80% compared with the absence of the bondable metal, Ulrich et al. teach using Au as the bondable metal and forming it to a sufficient thickness to obtain the claimed diffusion reduction.

Ulrich et al. does not explicitly state that the metallurgical connections between metal wires and bond pads are positioned on integrated circuits having copper interconnecting metallization. In paragraph 1 of the "Introduction" section, Ulrich et al. discuss the IC industry moving towards Cu-over-low-k chip architecture that may include polymers as the dielectric layers. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to use the bond pad metallization as claimed on integrated circuits. The motivation for using the bond pad metallization taught is that it allows wirebonding to bondpads which are located over thick polymer dielectric layers.

With regard to claim 8, Ulrich et al. teach the wire bonding step comprising ball bonding or wedge bonding.

With regard to claim 11, the step of activating is taught as immersing the bond pads in a catalytic chloride solution (see paragraph 5 of "Preparation of Test Structures" section).

With regard to claim 12, the metal chloride is palladium chloride.

With regard to claim 13, the electroless plating of the bondable metal is immersion plating (the substrate is placed in the solution for Au deposition, thus immersed, see paragraph 6 of "Preparation of Test Structures" section).

With regard to claim 15, the limitation of electrically probing leaving no probe marks is not limiting to the process of forming the device. This step does not change the device structure in any way during the process. Further, the device of Ulrich et al. is capable of performing the probing step without leaving any marks as the outermost bondable layer of Ulrich et al. is the same as in the present invention and thus would have the same hardness to resist probe marks.

With regard to claim 16, Ulrich et al. teach a method of forming metallurgical connections between metal wires and bond pads having copper metallization. Ulrich et al. teach the steps of:

depositing seed metal to activate the surface of the copper metallization of the bond pads (see paragraph 5 of "Preparation of Test Structures" section);

plating on the seed layer a layer of barrier metal that resist copper diffusion, by electroless deposition, the barrier metal having a thickness of at least about 0.5 micrometers selected from the group consisting of nickel, cobalt, chromium, molybdenum, titanium, tungsten, and alloys thereof (Ni deposited, see paragraph 5 of "Preparation of Test Structures" section);

plating on the barrier layer a layer of a bondable metal, by electroless deposition, the bondable layer having a thickness of at least about 0.4 micrometers selected from

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the group consisting of gold, palladium, platinum, and silver (Au deposited, see paragraph 5 of "Preparation of Test Structures" section);

and bonding one of the metal wires onto the outermost metal (wirebonding of gold to Cu bond pads, see abstract).

Ulrich et al. does not explicitly state that the metallurgical connections between metal wires and bond pads are positioned on integrated circuits having copper interconnecting metallization. In paragraph 1 of the "Introduction" section, Ulrich et al. discuss the IC industry moving towards Cu-over-low-k chip architecture that may include polymers as the dielectric layers. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to use the bond pad metallization as claimed on integrated circuits. The motivation for using the bond pad metallization taught is that it allows wirebonding to bondpads which are located over thick polymer dielectric layers.

With regard to claim 18, the barrier layer has a thickness in the range of about 0.5 to about 1.5 micrometers.

With regard to claim 19, the bondable layer has a thickness in the range of about 0.4 to about 1.5 micrometers.

With regard to claim 22, Ulrich et al. teach a method of forming metallurgical connections between metal wires and bond pads having copper metallization. Ulrich et al. teach the steps of:

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depositing palladium seed metal to activate the surface of the copper metallization of the bond pads (see paragraph 5 of "Preparation of Test Structures" section);

plating on the seed layer a layer of nickel, by electroless deposition, the layer of nickel having a thickness of at least about 0.5 micrometers; (Ni deposited, see paragraph 5 of "Preparation of Test Structures" section);

plating on the layer of nickel a layer of gold, by electroless deposition, the bondable layer having a thickness of at least about 0.4 micrometers (Au deposited, see paragraph 5 of "Preparation of Test Structures" section);

and bonding one of the metal wires onto the layer of gold (wirebonding of gold to Cu bond pads, see abstract).

Ulrich et al. does not explicitly state that the metallurgical connections between metal wires and bond pads are positioned on integrated circuits having copper interconnecting metallization. In paragraph 1 of the "Introduction" section, Ulrich et al. discuss the IC industry moving towards Cu-over-low-k chip architecture that may include polymers as the dielectric layers. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to use the bond pad metallization as claimed on integrated circuits. The motivation for using the bond pad metallization taught is that it allows wirebonding to bondpads which are located over thick polymer dielectric layers.

With regard to claim 24, the nickel layer has a thickness in the range of about 0.5 to about 1.5 micrometers.

With regard to claim 25, the gold layer has a thickness in the range of about 0.4 to about 1.5 micrometers.

3. Claims 9, 10, 20, 21 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ulrich et al. as applied to claims 7, 8, 11-13, 15, 16, 18, 19, 22, 24 and 25 above, and further in view of Ahmad et al. (U.S. Patent No. 6,436,412).

With regard to claims 9, 20 and 26, Ulrich et al. do not teach depositing a protective overcoat over the surface of the integrated circuit including the surface having copper and metallization opening selected areas of the overcoat exposing the surface of the copper metallization. Ahmad et al. teach a method of forming copper metallization with a bond pad. Ahmad et al. teach in figure 5E depositing a protective overcoat 50 and opening selected areas of the overcoat exposing the surface of the copper metallization.

Ulrich et al. and Ahmad et al. are combinable because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to form a protective overcoat and etch portions away to expose the copper. The motivation for doing so is provide a passivation layer over the substrate and to insulate the copper and bonded wire from adjacent conductors. Therefore, it would have been obvious to combine Ulrich et al. with Ahmad et al. to obtain the invention of claims 9, 20 and 26.



With regard to claims 10 and 21, Ulrich et al. teach cleaning before activating the copper surface. In combination with Ahmad et al., the cleaning step would be performed after the etching step to remove contaminants and cupric oxide. Ulrich et al. teach cleaning by immersing the exposed copper in a solution of sulfuric acid.

4. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ulrich et al. as applied to claims 7, 8, 11-13, 15, 16, 18, 19, 22, 24 and 25 above, and further in view of Gaudiello ("Autocatalytic Gold Plating Process for Electronic Packaging Applications," IEEE, Electronic Components and Technology Conference, 1995, Pp. 534-537).

With regard to claim 14, Ulrich et al. does not teach immersion plating followed by autocatalytic plating. Gaudiello teaches an autocatalytic electroless gold process for electronic packaging applications that is disclosed as a good follow on to the conventional electroless nickel/immersion gold surface finishing systems. Gaudiello thus teach immersion plating gold followed by autocatalytic plating.

Ulrich et al and Gaudiello are combinable because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to form the gold layer by immersion plating followed by autocatalytic plating. The motivation for doing so is to provide a high purity, nonporous soft gold layer of any thickness. Therefore, it would have been obvious to combine Ulrich et al. with Gaudiello to obtain the invention of claim 14.

***Allowable Subject Matter***

5. Claims 17 and 23 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

***Response to Arguments***

6. Applicant's arguments filed 1/30/04 have been fully considered but they are not persuasive.

Applicant has argued that the Ulrich et al. publication has no actual date of publication thereon and as such no prima facie case of obviousness has been established. First, the examiner notes that the Ulrich et al. publication is from the 1999 International Conference on High Density Packaging and MCM's and as such has been treated as having been published or presented to public knowledge in 1999. Any date in 1999 qualifies as prior art in the instant application. Further, the examiner provides herewith evidence of the actual publication date of the reference. This evidence is a printout from a commercial database that shows that the Ulrich et al. reference was available as prior art as of April 6, 1999. The evidence is listed on an attached PTO-948. Thus, for the purposes of the rejections in this Office Action, the reference is considered having been available as prior art as of April 6, 1999 and thus qualifies as a prior art reference under 35 U.S.C 102(a).

Applicant's further arguments stating that logic would dictate that the inventors had conceived of the invention before the reference and therefore would likely be able

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to swear back of Ulrich et al. are immaterial as no evidence exists on the record of any prior conception. Until such time as the inventors provide clear and convincing evidence that they conceived of the invention before the Ulrich et al. reference and show any necessary due diligence the Ulrich et al. reference is properly treated as prior art.

### ***Conclusion***

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).


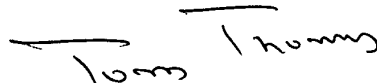
A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to N. Drew Richards whose telephone number is (571) 272-1736. The examiner can normally be reached on M-F 8:00-5:30; Every other Friday off.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (571) 272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

  
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